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Value of the duodenal tube with special reference to diagnosis of biliary disease

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THE VALUE OF THE DUODENAL TUBE WITH SPECIAL REFERENCE TO DIAGNOSIS OF BILIARY DISEASE

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HISTORY

In order to have arrived at the modern technic of gastro-duodenal intubation, it was of course necessary to establish some instrument for intubating the stomach and duodenum with the recovery of their respective secretions. As simple as the problem seems today, the discovery and developement of such instruments was somewhat slow, and the discovery and first practical use of such instruments occured only some one hundred and twenty -two years ago.

Philip A. Physick, professor of surgery in the University of Pennsylvania, published his original paper describing his stomach tube in October 1812. Apparently he had invented and used this tube as early as 1800, but had acknowledged that credit for the invention should be given to Dr. Alexander Monroe, of Edinburgh, who had suggested the idea in 1797. (36)

For some reason Physick's contribution was not known in Europe. Jukes published a description of his tube in 1822, and for sometime was given credit for its first discovery.

At this time the stomach tube was used almost entirely for the removal of various poisons from human stomachs, and also cattle. Kussmal, in 1876, relieved

gastric distress and realized that the stomach tube might cure cases of gastric dilation by lavage. He also conceived of its possibilities in diagnosis. From this time on, there was an enthusiastic study of the digestive physiology, Chemistry, and pathology. Various test meals were advocated by Ewald, Boas, Riegel, and others.

There was no great advance made until the large stiff tubes first in vogue, were replaced by soft rubber tubes of large caliber by Ewald and Oser, in 1875.

About twenty years later, Hemmeter, of Baltimore, published his report in 1895, of an inflatable rubber balloon attached to the end of a stomach tube, and which had a guide at the lesser curvature through which the duodenal tube glided. At this time Hemmeter attempted studies in duodenal physiology. (25)

Later, Kuhn devised a tube consisting of a very flexible thin steel spiral tube, which was pushed through a thin stomach tube.

In 1898, Fenton B. Turck intubated the duodenum, using a small calibered rubber tube.

Max Einhorn presented the first tube with a metal tip and published his report in 1909. From this time on there has been many changes in the duodenal tube by different men. The changes consist mostly in the type

and construction of the metal tip. In 1921, Levin (35) advocated the use of a tipless gastro-duodenal catheter and suggested introducing it through the nose.

INDICATIONS FOR USE OF THE DUODENAL TUBE.

The duodenal tube is indicated for diagnosis and therapeutics.

From a diagnostic standpoint, it is valuable in determining the patency of the nostrils (Levin tube) (34), esophagus, cardia, and pylorus and in obtaining gastric, and duodenal contents, bile, and pancreatic ferments for examination.

The diagnostic help from the esophageal area is far less than from the esophagoscope or X-Ray (38). But one can determine obstruction of the esophagus and is aided in differentiating cardio spasm, esophagitis, and malignancy. When it fails to pass to the stomach it indicates obstruction of some variety. Gentle aspiration may recover fluid-turbid, mucoid, or blood streaked, containing debris which when properly examined (stained and unstained) often shows food retention, inflammatory products, pus cells, bacteria, exfoliated flat or diamond shaped squamous epithelium in esophagitis and diverticulitis. In malignancy areas of necrotic slough or recognizable cancer cells may sometimes be seen (37,38).

In the gastric area from examination of the gastric residuum, and secretory response to test meals,

we can obtain information which will corroborate and supplement that provided by X-Ray in organic lesions and may also furnish evidence of gastritis, catarrh, or various reflex or functional disorders not recognizable by X-Ray alone.

The diagnostic aid of the duodenal tube from the duodenal area will be reviewed in the latter part of this paper, the major part of the discussion of which will be with reference to the value of the duodenal tube in diagnosis of biliary diseases.

The therapeutic uses to which the duodenal tube has been put are many and varied. The stomach and duodenum can be washed with water or medicated solutions, poison removed, and neutralized. The stomach and upper intestinal tract can be drained (34). In certain conditions, such as peritonitis and obstruction the intestinal gradient is disturbed so that material is excreted rather than absorbed in the small intestine. The tube introduced following operation allows cleansing of the stomach and, if left in place, prevents post operative distention of the upper gastrointestinal tract and adds to the comfort of the patient.

According to McIvers et al (44), the source of gases in distention are three fold; (1) from decomposition of intestinal contents, (2) diffusion of blood gases into

intestinal lumen, (3) passage of atmospheric air from stomach (swallowed air). The use of the duodenal tube prevents accumulation of air in stomach and reduces distention.

Paine et al (46) conclude that swallowed air is the greatest source of gas and that the fluid accumulation from stasis gives rise to nausea and vomiting. Hence removal of swallowed air and fluid from stomach and duodenum relieves nausea, vomiting, and distention.

Wangesteen, Brown, Paine (59,9,46) and others, advocate the use of the duodenal tube with constant suction siphonage in treatment of acute intestinal obstruction. Wangensteen (59,60) reports nine out of twelve cases satisfactorily decompressed by nasal suction siphonage alone. He reports seven cases satisfactorily treated, five of which needed no subsequent operation for release of obstructing cause. This has largely replaced surgical enterostomy.

Intubation has been advocated for release of tension on suture lines from strain of vomiting and distention. Brown (8) advocates passing the tube (especially in abdominal hernia) while the patient is on the operating table and leaving it until the period of vomiting is over.

Brown quotes J. T. Case as curing duodenal fistula by use of the tube in the duodenum. Ruddy (53) reports a case of duodenum fistula following the closure of a duodenal perforation which failed to hold. The duodenal tube was used rather than a gastro-enterostomy. The tube was left in situ and the fistula closed in seventeen days.

The duodenal tube has found considerable use in Urology in pre and post operative cases with relation to acute retention of nitrogenous products and control of acid base balance. Young (63) has used the inlying or retained duodenal tube where there was nausea and vomiting secondary to renal disease with subsequent recovery of uremic patient by forcing fluid and nutrition by this means. He has also used the same treatment in uremia from enlarged prostates with gratifying results. La Rochelle (34) states that duodenal lavage is almost specific for hiccup in uremic cases.

The duodenal tube has been used in cases of hyperthyroidism by Jackson (30) to insure fluid intake and iodine. He feels that he controls post operative crises by this means. Those toxic patients with inability to take iodine without vomiting respond to such treatment.

Einhorn (15) recommends its use in treatment of post operative gastric ileus, following gastro-enterostomy.

Passing the tube and washing the stomach relieves vomiting. It can be passed on into the duodenum with feeding through the tube.

Levy-Solal, and Hedges (34) have demonstrated good results with the use of duodenal tube in controlling nausea and vomiting in toxemias of pregnancy.

Herbert Gunn (21) substantiates the conclusions of Gnott, Weist and Schneider that with the use of the duodenal tube in treatment of tape worms (1) the treatment was more efficacious than when given by mouth, (2) nausea and vomiting occur much more rarely, (3) toxic symptoms are much less evident, and (4) the worms are usually expelled intact.

Brown (8) suggests that the duodenal tube should be used for feeding purposes in all cases of prolonged vomiting from gastric ulcers, pyloric obstruction, marasmus, or where there is indication for fluid or nourishment. In this connection Barker (3) presents a case of severe anemia of Addison Biermer type with persistent vomiting who recovered by administration of liver extract through the duodenal tube.

Rudolph Matas (8) used the duodenal tube in Typhoid cases with severe toxemia and distention permitting the tube to go to the small intestine. He used constant lavage with the water going through the bowel and out

through the rectal tube.

Lyon (33) claims that preoperative duodenal drainages in cases of jaundice reduces the jaundice and infection in cases of infection of the ducts. Post operative drainages following Cholecystectomy for Cholecystitis aids in removing residual infection and guards against infection of the intestinal tract. He recommends it as an alternative means in the treatment of acute gall bladder disease where there is surgical contra-indication. Continuous drainage aids in clearing up post operative biliary fistula. He also recommends it as an aid in clearing up foci of infection in the gall bladder giving rise to arthritic manifestations.

Caviness (10) states that cholecystis and cholangitis often yield readily to treatment by duodenal intubation, although failures occur occassionally. Acute cholecystitis yields more readily than chronic, but in some chronic cases satisfactory results are often obtained. Cholangitis with or without jaundice yields to duodenal drainage more readily than cholecystitis. Several drainages may be necessary before there are any signs of improvement, but recovery usually follows a few drainages. A small stone producing jaundice can occasionally be dislodged and the jaundice relieved by

intubation, but usually cholelithiasis is a surgical condition.

La Rochelle (34) states that intubation relieves nausea and may promote the flow of bile into the duodenum and relieve pyloric spasm. In cases of biliary colic used with morphine and hot applications to the abdomen it is a very satisfactory treatment for acute colic.

The real value of biliary drainage in treatment of diseases of the gall bladder and ducts has been doubted by Dunn, Howard, Whitaker (14,29,62) and others on the basis that there is a higher concentration of magnesium sulphate in the duodenum following oral administration than with a single stimulation through the duodenal tube as observed by Dunn and confirmed by Howard. Whitaker found greater contraction of the gall bladder following fatty meals than with magnesium sulphate.

According to Schneyer (55) Jutte believes that due to the factor of intestinal stasis good results can be obtained in some cases from duodenal lavage in such conditions as rheumatism, gout, arteriosclerosis, nephritis, toxemia of pregnancy, cirrhosis of the liver, intestinal stasis, anemia, skin diseases, catarrhal inflammations of the mucous membranes, mucous colitis, neurosis, neuritis, insomnia, and epilepsy.

TECHNIC OF DUODENAL INTUBATION

Lyon (34) recommends a tube 110 centimeters in length, fairly stiff rubber of a caliber of 3-4 millimeters, and a lumen of at least two millimeters, outfitted with any one of a number of metal tips. He prefers the one of his own design (37) with an opening in the distal end. There should be an observation window, glass canula, at the proximal end. The tube should be marked at 55 cm. and 75 cm., the figures representing the average distance from the incisor teeth to the greater curature of the stomach and to the ampulla of Vater respectively.

Levin (35) advocates the use of the Levin tube by nasal route, because of (1) no tickling of soft pallate, (2) no choking sensation, hardly any excessive production of pharyngial mucus, and great deal less discomfort to the patient. The alleged advantages (35) (31) of the Levin tube are; (1) the Levin tube is 45" long and comes in sizes from numbers 12-18 French (small tube can be used in infant and nasal obstruction). (2) the absence of the metal tip and flexible quality of the rubber facilitates its introduction through the nostril or mouth, (3) the walls of the tube do not tend to collapse when suction is applied, (4) the openings do

not tend to become blocked by mucus or food on account of their size and velvet eye terminal end, (5) no stylet is needed, (6) the tube can be introduced through nostril or mouth even if the patient is anaesthetized, (7) it is less likely to curl up in the stomach, (8) the tube is opaque to X-Rays.

Twiss (58) prefers a tube with a metal tip. He claims that the metal tip by virtue of its weight aids in passing the pylorus. Twiss recommends either the ones of Rehfus or Lyon, but especially the one of his own design which includes a larger tubing, a metal tip of smaller diameter, and with a terminal weight which is alleged to act as a leader in drawing the bucket into the duodenum.

Intubation should be done after a twelve hour fast. If the bile is to be cultured, the mouth should be thoroughly cleansed. Lyon (34) recommends mild solution of zinc chloride and formalin, and potassium permanganate 1-500. The tube(sterile)is passed by mouth or nostril to the 55 cm. mark. Then the stomach is thoroughly lavaged and one hundred cubic centimeters of water left in the stomach to stimulate peristalsis. The patient then turns on the right side and slowly swallows a centimeter of tube each minute so that when the tip impinges at the pylorus, it will remain there for one

minute and have several chances to be carried through into the duodenum by the next peristaltic wave. By the time the tube has been swallowed to the 75 cm. mark, it is usually found to be in the second portion of the duodenum and in close relation to the common bile and pancreatic ducts. (36,38,10,55,etc).

To determine if the tip of the tube has reached the duodenum a series of clinical tests may be carried out or the tip visualized by X-Rays. No attempt should be made to determine this until transit time of twenty minutes has elapsed. The X-Ray is obviously the most accurate. In absence of the X-Ray the following clinical tests may be relied upon; (1) The so called duodenal or traction tug, which is comparatively unreliable. (2) Testing the acidity of the duodenal fluid by Topfers method compared to the acidity already determined in the fasting gastric residuum. As a rule it is either negative for free hydrochloric acid or appreciably less. (3) Some diagnostic help is gained by the ease with which the aspirating bulb of a one ounce syringe can be used without producing suction collapse of the rubber tube. When the tube is in the duodenum very much less air suction can be made than when the tip is in the stomach. (4) With the patient drinking a glassful of water if the

tip is in the stomach a large amount of the water will be returned. When the tip is in the duodenum we get practically no return. This interfers with accurate diagnostic study, however. (5) The most reliable clinical test consists of injecting one or two ounces of air through the tube and with stethoscopic auscultation for the location of maximum air explosion. If best heard in the duodenal area above and to the right of the umbilious it is probably in the duodenum. When in the duodenum the air explosion is finer and carries a higher pitch than when in the stomach.

When relying on the clinical tests for position of the tube, if the tube has not entered the duodenum, it is best to pull it out to the stomach mark and again re-swallow.

With adhesions or organic obstruction the transit time may be delayed. Cases of pylorospasm usually respond to ascending doses of belladonna for three or four days or to introducing through the tube tincture of belladonna m. XV. and sodium bromide gr. XV. often combined with a hypodermic of atrophine gr. 1/100.

Morgenstern (45) advocates introduction under fluoroscope to shorten time of transit. In his series of forty cases the tube was inserted into the duodenum in two to ten minutes. Using the Levin tube the patient is placed

behind the fluoroscope. As soon as the tube is in the middle region of the stomach, the operators left hand is pressed against the abdomen in the region of the greater curvature in an upward direction to raise the greater curvature to the level of the pyloric sphincter. The tube is slowly swallowed and guided toward the pylorus by the operators right hand. It is gradually massaged into the first portion of the duodenum and held while the patient swallows enough to make a loop along the greater curvature. The spastic pylorus is overcome the same as by other technic.

Rousselot's (52) new technic is carried out as follows. The patient is placed in the supine position on a fluoroscopic table. A duodenal tube, internal diameter 35 mm., with an Einhorn tip, is stiffened with number 11 gage piano wire. To prevent passage of the wire through the perforations of the Einhorn bucket, a small oval bead of lead is soldered onto the end of the wire. This is passed into the stomach. After the tube has entered the cardia, the wire is withdrawn 2.5 cm. and the patient is turned on the right side. The tube is then passed to the pylorus under fluoroscopic control. The wire is then farther withdrawn to a point 5 cm. from the tip. After from 3-15 minutes, and with the aid of gentle manipulation, the flexible

end of the tube is carried through the pylorus by peristaltic activity into the second part of the duodenum. The wire stylet is then completely removed, and the duodenal contents removed by aspiration.

The spraying of the nose and throat with 4-5 per-cent cocaine solution is recommended by Caviness, Rousselot, (10,52), and others to alloy gagging and discomfort in passing the tube, especially in nervous patients.

Having reached the duodenum, the duodenal fluid is aspirated and retained for study. For securing gall bladder bile fraction the best chemical stimulants intra duodenally are Magnesium Sulphate, peptone (representing one end product of protein digestion), olive oil, and oleic acid both representing stimulation by fat). (38)

The most used substance is magnesium sulphate. This is injected as saturated solution at body temperature, (used from 16 to 33 1/3 per cent according to different authors) in varying amounts according to different workers. Lyon injects 75 cc., Bartle (4) 37-75 cc., and Hollander (28) injects one ounce. The tube is clamped off for three minutes and then reopened, and the return watched until the dark bile begins to appear. Thirty or more drops are run into the culture tube containing hormone broth, if culture is desired. The bile is collected in different containers with each change in

bile color.

Some workers examine the bile without centrifuging (Rafsky (49)), others centrifue before microscopic examination.

Duodenal lavage as suggested by Jutte, Schneyer (32,55), and others is carried out by the slow introduction of 1000cc. of solution made up of 9 grams each of sodium sulphate and sodium chloride and warm water up to 1000 cc. Ten minutes is taken to introduce the solution. It is isotonic and does not cause withdrawal of fluid from the intestine or absorption into the intestine. Flushing takes place through the entire alimentary tract and removes any deleterious substances that might be present.

ORIGIN OF "B" BILE.

Although according to some workers, biliary drainage, especially with reference to cholelithiasis (Rafsky (49)), is of considerable diagnostic value without consideration of the origin of the various bile fractions, it seems necessary to review the physiology of the gall bladder with respect to the origin of the so called "B" bile in order to follow and establish some of the finer diagnostic points suggested by Lyon, Hollander (38,36,27,28) and others.

The physiology of the gall bladder is not as yet well known, but it has been definitely established by Rous and McMaster (50) and confirmed by Mann and Bollman, (39) and others that the gall bladders has a concentrating function to the point of ten times that of liver bile, as well as the function of storage.

Lyon originally segregated the bile, following a suggestion from Meltzer, into "A", "B", and "C" bile as coming from the common duct, gall bladder, and hepatic ducts respectively. Alvarez, Einhorn, Jones, Crohn, Bassler (1), (15,31,11,6) have doubted the correctness and diagnostic value of the segregation.

Crohn (11) injected methylene blue into the gall bladder of dogs and irrigated the papilla of Vater and

duodenum with Magnesium sulphate solution and failed to elicite a flow of dark bile containing methylene blue, but on compressing the gall bladder manually did produce a flow of dark bile containing methylene blue and consequently showed that the dark so called "B" bile did come from the gall bladder, although under his experimental conditions magnesium sulphate did not stimulate the flow.

Bassler (6) contended that there was no evidence that the gall bladder was drained by Lyon's method since in two operative cases examined by Bassler with the duodenal tube in situ there was no evidence of gall bladder action or any visable reason to suggest that any contraction took place or that the characteristic dark colored bile, when obtained, was from the gall bladder.

Sachs (54), however, reported a case which at operation, with the duodenal tube in situ, when stimulated with magnesium sulphate showed contraction of the gall bladder and recovery of dark "B" bile by the tube. Lyon suggests that possibly the failure to elicite response at operation and animal experimentation is due to the anaesthesia.

The experimental results on dogs of Auster and Crohn (2), Friedenwald, Martindale, and Kearney (20) and the work by Diamond (13) who failed to show expulsion

into the duodenum of carmine, (except rare microscopic particles) previously injected into the gall bladder of dogs with duodenal fistula lead Jones (31) to the conclusion that the significance of the sequence of "A", "B", and "C" biles was unquestionably destroyed and he explains the changes in bile color and concentration on the basis of the greatest relaxation of the sphincter by the magnesium sulphate, as accounting for so called "B" bile.

Higgins and Mann (24) have shown in their experiments with dogs that the gall bladder does empty invariably following fat meals, that it empties through the cystic duct, and that it empties through its own volition, the contractions being sometimes by portions giving rise to hexagonal contours.

Silverman and Manville (58) report a series of cases in which duodenal drainage was done and checked by cholecystogrophy, Grahan Cole method. With the obtaining of the characteristic "B" bile they noted diminution in size and shape of gall bladder as recorded by cholecystography. Their conclusion being that there was drainage of the gall bladder by the duodenal tube. This has been confirmed by Whitaker (62).

Lake (33) gave patients 60 grains of tetraiodo phenolphthalein. He fluoroscoped the patients and took X-Ray

plates to determine the size of the gall bladder and then proceeded with biliary drainage using magnesium sulphate and olive oil respectively. He reports that the recovery of one ounce or more of dark greenish, brownish or black bile is accompanied by a considerable decrease in the size of the gall bladder shadow or (in one case) its disappearance. The bile was analysed for iodine content and it was found that the dark bile ("B") contained an average of 48 times as much iodine as the bile preceeding it and 10 times as much as the bile following it. When no dark bile was recovered even though large amounts of yellow bile appeared, the gall bladder shadow was absent or did not decrease in size.

Although there has been much conficting opinion and experimental results, it seems that at the present time it is generally assumed that the dark bile ("B") does come from the gall bladder in most instances, with a few possible exceptions i.e. dilatation of the ducts following cholecystectomy (36) and according to Einhorn (17) the darker coloration of bile is sometimes due to more intensive work of the liver.

DUODENAL AND BILIARY DRAINAGE.

The diagnostic value of duodenal drainage lies in the recovery and examination grossly, microscopically and chemically of duodenal contents.

Normal duodenal fluid recovered from a fasting duodenum is generally a gray, translucent, mucoid, fluid. The amount of normal fasting juice is rarely over 20 cc. It is alkaline to limus or neutral. Lyon (36) believes there should be no bile in the fasting stage (unless there has been considerable gagging on passing the tube) normally and that gross bile suggests dysfunction of Oddi's sphincter either compensatory or pathological, since it is most often found in connection with peptic ulcers, duodenitis, cholecystitis, colitis, and cholecystectomized cases, or those who have had a gastroenterostomy.

Normally duodenal fluid shows only an occassional unbile stained, pearly gray, oval or cuboidal epethelial cell; never more than 20-30 per low power field together with small flakes of mucus not intimotely associated with duodenal cells, only on occassional white blood cell, and a scattering of bacteria not in clumps.

In duodemitis or other pathological states of the duodenum, there will be found enormous numbers of exfol-

iated duodenal cells in various stages of degeneration often several hundred per low power field. There is also microscopic evidence of inflammation with an outpouring of white blood cells, proliferated bacterial flora, and in acute duodenitis, duodenal ulcers, cancer of the head of the pancreas, or bile duct. Red blood cells may be observed (care must be taken to rule out trauma or occult blood from stomach, esophagus, or mouth).

Evidence of 15-18 hour food retention, meat fibers, vegetable cells etc. is significant of duodenal adhesions, pressure retention, or diverticulitis. The differential diagnosis can be made only by X-Ray.

Intestinal parasites are often recovered. The most frequent one is giardia or lamblia intestinalis. Lyon (37) reports twenty cases in which most gave no clinical findings otherwise to suggest its presence.

Through the duodenal tube samples of pancreatic fluid may be obtained for direct test of its enzymatic efficiency. Such fluid is rarely ever pure, but is mixed with duodenal, bile, and sometimes gastric juice. Bassler uses peptone solution as a stimulant for pancreatic secretion and collects the first bile recovered for its determination. Apparently the most acceptable tests for pancreatic ferments are those proposed by Lueders, Bergheim, and Rehfus (40), McClure, Witmore and Reynolds (43) and Bassler (5).

The diagnostic value of biliary drainage lies in a careful microscopic examination of the bile fraction, the cultural evidence, and to a lesser extent chemical studies. The chemical methods are at the present time too insufficiently advanced to be of any great aid.

Normally, the sequence of bile drainage consists of the so called "A" bile, a light bile of 5-30 cc. in amount, the "B" bile, darker, more viscid, green, brownish or blackish bile, one to several ounces in amount, assumed to be from the gall bladder, and the "C" bile, one to several ounces of lighter and thinner lemon to straw colored bile, which is supposed to be freshly secreted liver bile.

Einhorn, Lyons, Smithies, Piersol, Hollander, Jones (15,18,36,38,37,47,26,27,31), and others have described the elements in the bile that they believe to be of diagnostic value. Bassler, Crohn, Fitz, Hartman, Cutler, Alvarex (6,11, 19,22,12,1), and others have doubted the reliability of microscopic examination of bile.

Max Einhorn in 1914, reported studies made on the duodenal fluid and bile in which he noted mucus in the duodenal fluid of catarrhal jaundice and suggested that turbid bile was suggestive of diseased gall bladder. He reported finding cholesterin crystals in the bile.

Later, Einhorn (15) reported series of cases in which he found cholesterin crystals, calcium bilirubin, sand like particles, pus, bacteria, and mucus. He considered the presence of conglomeration of cholesterin crystals as suggestive of calculi. He believes that the sand like particles, though not always indicative of stones, do indicate gall bladder pathology.

Jones (31) found cholesterin crystals, bilerubin (or calcium bilirubinate), bile stained cells, and concludes that in cases of cholilithiasis characteristic elements are found which consist of abnormal amounts of any of the above. In a series of 48 cases of cholelithiasis, 97 per cent showed excessive precipitate of cholesterin, calcium, or bilirubin crystals.

According to Lyon (38,36) bile microscopy in cases of cholelithiasis shows numerous crystals more commonly cholesterin, calcium, and bilirubin, and sometimes gall stone sand. Occassionally leucin, tyrocin, and hippuric acid crystals are found.

Piersol, Bockus, and Shay (48) conclude that bilirubin calcium pigment or calcium bilerubinate has been in the bile drained from the duodenum with sufficient constancy to give it significance in diagnosis of gall stone. They report 42 cases of cholelithiasis drained preoperatively, 73.8 per cent showed calcium bilirubinate or

cholesterol crystals and calcium bilirubinate pigment proved to be gall stones. In the majority of these cases these elements were only found in the "B" bile. A preoperative estimate of gall bladder function proved correct in 88 per cent of cases.

In thirty cases, which had appreciable bile in the gall bladder at operation, in all but three "B" bile was obtained. This is compared with cholecystography (oral) i in which method preoperative estimate of gall bladder function proved correct in only 65 per cent of cases.

According to Hollander (27) there are four elements that are characteristics of bile that are not present in gastric or duodenal fluids, and hence cannot be confused with them; (1) flocculi of bile stained columnar cells with or without bile stained leucocytes or colonizing bacteria enmeshed in mucus. These cells are differentiated from those of the stomach and duodenum by their uniform bile stained, tall, narrow shape, and fine granular cytoplasm. (2) Particle of intensely bile stained debris usually appearing macroscopically as yellowish or reddish particles (pin head in size). Microscopically these are granular, intensely yellow with small spots scattered throughout, having the appearance of conglomerate cellular nuclei. These are called by other author s

bilirubin calcium pigment. (3) Agminated cholesterin crystals occur as independent masses of conglomerate crystals, but more frequently precipitated upon floccules of bile stained columnar epithelium, or upon particles of intensely bile stained debris. Not infrequently they appear massed together in the form of small calculi. They appear grossly as whitish pin point sized particles. (4) Sand like particles which are microscopic particles varying in size from the head of a pin to a grape seed. They are black, brown, or red, and are of a gritty or pultaceous consistency.

These elements were seen in bile from both gall bladder and ducts except the agminated cholesterin crystals which occured only in gall bladder bile.

Bockus et al (7) compared the diagnostic value of biliary drainage and cholecystography in 148 cases of cholelithiasis proved by operation or autopsy, which had been studied preoperatively by biliary drainage or cholecystography or both, Cholesterol crystals or bilirubin calcium pigment or both were recovered in 119 out of 143 cases studied by drainage or 83 per cent. Bockus emphasizes the point that more than one drain age (2 to 3 or more) were necessary in 44 of the 119 cases, the examination being repeated in cases with no "B" bile or only a trace.

A cholecystographic study was made in 96 of these cases (oral or intra venus). A positive stone diagnosis was made in 29 per cent and evidence of pathological gall bladder was obtained in 88 per cent. With biliary drainage positive stone or evidence of deficient function as evidenced by no "B" bile or very slight amount was present in 98 per cent of cases.

They concluded that the presence of cholesterin crystals and calcium bilirubinate pigment both are pathognomonic of gall stones. Cholesterin crystals alone are 89 per cent accurate, and bilirubin calcium pigment alone 90 per cent accurate.

Rousselot and Bauman (52) concluded that the absence of crystals or pigment granules in the concentrated bile "B" bile is fairly strong evidence against the presence of stones and that the finding of cholesterol crystals or pigment granules (calcium bilirubinate pigment) in dilute ("A" Bile) or concentrated ("B" Bile) almost certainly indicated the presence of gall stones. The absence of crystals or pigment granules in dilute bile ("A" bile) or failure to recover "B" bile is not conclusive evidence of pathological changes in the gall bladder or the absence of stones.

Rafsky (39) compared the findings from preoperative biliary drainages with those of bile or scrapings of

stones obtained from the gall bladder at operation and found them strikingly similar. He found cholesterol crystals, calcium bilirubinate crystals, and in a few cases calcium carbonate crystals. He divides calcium bilirubinate crystals into two classes (1) the brick red or dark brown amorphous masses and (2) the light brown or amber colored granules.

Rafsky emphasises the point that in evaluating the diagnostic importance of the crystaline elements in preoperative specimens of bile, one should keep in mind the amount of pigment observed in the bile. A few scattered crystals or small amount of calcium bilirubinate pigment occurring separately or together has not much significance, but numerous cholesterol crystals and pigment, together or separately, does in most cases indicate calculus or non calculus cholecystitis. The proper interpretation of bile microscopy may be the only method of establishing the diagnosis.

Sixty-nine patients in whom biliary crystals were found preoperatively came to operation and 63 (91.3%) were found to have calculus or non calculus cholecystitis. Of these patients forty-seven gave history of typical gall bladder disease. In twenty-two the gastric symptoms did not point to gall bladder disease. Only fifty-

six of these cases gave any evidence of cholelithiasis or gall bladder pathology by cholecystography (oral).

Bile microscopy in several of these cases was the only method of arriving at a definite diagnosis since cholecystograms were negative and the history did not point toward gall bladder disease.

Hollander (28) suggests a standard by which to determine the normal volume and color of "B" bile. He uses a colorimeter of Sahli type with a 0.7 per cent aqueous solution of potasium bichromati to represent the maximum color of liver bile, and darker bile is called "B" bile. The bile diluted with water matches the standard exactly unless large amounts of biliverdin are present. The color intensity of the bile acoording to Hollander is expressed by the number of times its volume must be diluted with water to match the standard. Thus, one volume of water added to an equal volume of "B" bile used in order to match the standard the color intensity is 1, if two volumes of water are used the color intensity is 2, etc.

Hollander found that when the volume of "B" bile was 25 cc. or more with a color intensity of 1, or more the gall bladder at operation was normal or approximately normal in size and appearance and functioning through an open cystic duct. When no "B" bile was obtained the gall bladder was grossly deseased.

One ounce of magnesium sulphate is used for stimulation. If no bile is obtained that is darker than the standard three such injections are used before concluding that no "B" bile is present. In case "B" bile flows but stops it is restimulated until 25 cc. or more (normal amount) of color intensity of one is obtained, or until no "B" bile is discharged in a ten minute period following the last injection of magnesium sulphate.

Using this technic, Hollander found evidence of pathologic gall bladder in 96 per cent of one hundred proven cases of cholelithiases. Gross disease of the gall bladder was present when (1) no "B" bile was obtained, (2) when 1/5-2/5 of the normal amount of "B" bile without cholesterin crystals, and (3) when 1/5-4/5 of the normal amount of "B" bile was obtained with the presence of agminated cholesterol crystal. In 4 per cent of the cases of cholelithiasis in which small calculi were present in normal sized gall bladders the amount of "B" bile was normal and agminated cholesterol crystals were absent.

Lyon (38) believes that the early catarrhal process in many cases may be localized chiefly within the cystic duct producing abnormal retention and injury to the gall bladder mucosa and walls, but without the jaundice of catarrhal obstruction of the common or hepatic ducts to direct attention to the possibility. This obstructed condition can be recognized only by cholecystography or duodenal drainage and Lyon maintains that duodenal drain-

age is more accurate in differentiating between obstruction due to cararrh, impacted stone, stricture, angulation etc., than cholecystography.

In obstruction due to catarrh, according to Lyon, there is a definite drainage sequence and characteristic microscopical picture. The obstruction may be complete or partial. Either no "B" bile or only small amounts may be recovered and is then preceeded or accompanied by characteristic floccules of yellow brown mucus in shaggy slimy masses. Among the mucopus floccules denser shreddy floccules of dense mucus often encrusted with bile salts are found.

The most important finding, according to Lyon, is an oleaginous material, pale to bright chrome yellow color occuring in globules, pols, and lakes. If these bright yellow flecks are pipetted into a porcelain dish and pressed out, they coat the dish like butter. (the oleaginous material is fluid and on a slide under a cover slip seems to melt out from the depths of dense mucus strands).

If infection has taken place and the inflammation passes beyond the catarrhal stage, there will be bile stained colonies of culturably viable bacteria, collections of pus, and often exfoliation of bile stained columnar epithelium.

In acute and subacute, and less often in chronic

cholecystis, there is usually an increase in bile stained flocculeS. Microscopically there are tall columnar cells, often in a rosett cluster, increased mucus, often encrusted with bile salts, and abnormal numbers of leucocytes, the number of bile stained polymorphonuclears being a fair indication of the degree of inflammation. Short columnar epithelium may be derived from gall bladder or ducts, usually from the ducts. All cells and other products of gall bladder, (mucus, leucocytes, bacteria) are invariably bile stained and , hence this differentiates them from those originating in the duodenum and stomach.

Aside from Lyon's work, there is very little more than mere mention of bile culture in the later literature. Although there seems to be considerable difference of opinion as to its value, Lyon (38) cultures the bile in Huntoon's hormone broth or Rosenow's brain glucose broth, and feels that the cultural finding are of value if proper technic, with thorough cleansing of the mouth and stomach is carried out.

After incubating for 18-24 hourse at 37 degrees centigrade, if a growth is noted in the flask containing the broth it is plated on blood agar plates and subcultured for differentiation. If no growth is noted in the flask, or demonstrable by hanging drop methods at the end of 72 hours, it is considered sterile.

If the cultural identification checks with the types of bacteria observed in freshly examined cover slip preparations made at the time of drainage. Lyon considers it to be of importance.

Bartle (4) states that, "if the bile in the collection bottles is crystal clear, one may expect ninety-five times in one hundred a sterile cultural report from the laboratory. Conversely of sedement is found either as fine feathery flakes or the other extreme as a definitely measureable precipitate, a positive bacteriological report will reach you. The least offensive bile may containe streptococci or staphylococci. Bacillus Coli infection can frequently be foretold by the disagreeable odor of the bile".

There are a number of factors to be taken into consideration when evaluating the evidence obtained by biliary drainage. First the drainage should be carried out with the proper technic. A second or third stimulation with magnesium sulphate should be used especially when no "B" bile is obtained by first stimulation.

Hollander (28) states that practically all authors who report that biliary drainages are unreliable in diagnosis used only one injection of magnesium sulphate.

The bile when obtained should be examined immediately since the contents are rapidly changed by action of

enzymes etc., of the fluid (38,4,10 etc.).

If the information desired is not obtained at first drainage, a second, third or even more drainages should be done.

According to Lyon (38) when there is disagreement between the nonvisualized G. B. of the Graham Cole test and the biliary drainage findings caution should be observed in sanctioning an immediate operation, since catarrhal cystic duct obstruction is responsible for a large number of these instances. (According to him, this condition responds to several biliary drainage in most cases).

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